1. A method comprising:

providing a first signal segment corresponding to a first geological formation having a first characteristic;

providing a second signal segment corresponding to a second geological formation having a second characteristic, distinct from the first characteristic;

expanding the first and second signal segments in at least one of frequency space and time space by applying at least one feature operator to the first and second signal segments to generate a plurality of first feature segments corresponding to the first signal segment and a plurality of second feature segments corresponding to the second signal segment;

weighting the pluralities of first and second feature segments by applying a weight table to the pluralities of first and second feature segments to generate a weighted plurality of first feature segments and a weighted plurality of second feature segments, respectively; and

collapsing the weighted plurality of first feature segments to form a first feature comprising a non-random first pattern and the weighted plurality of second feature segments to form a second feature having a second pattern distinct from the non-random first pattern.

2. The method of claim 1, further comprising generating a separation key listing the at least one feature operator used to expand the first and second signal segments and the weighting table applied to the pluralities of first and second feature segments.

3. The method of claim 2, further comprising providing a third signal segment corresponding to a third geological formation.

4. The method of claim 3, further comprising expanding, weighting, and collapsing the third signal segment in accordance with the at least one feature operator and weighting table listed in the separation key to generate a third feature.

5   5. The method of claim 4, further comprising classifying the third geological formation as having one of the first and second characteristics based on the correspondence of the third feature to one of the first feature and the second feature.

6. The method of claim 5, wherein the first characteristic is selected from the group

10   consisting of porosity above a first threshold value, density above a second threshold value, pressure above a third threshold value, shale in a concentration above a fourth threshold value, hydrocarbon production above a fifth threshold value, temperature above a sixth threshold value, and sand in a concentration above a seventh threshold value.

15   7. The method of claim 6, wherein the second characteristic is selected from the group consisting of porosity below the first threshold value, density below the second threshold value, pressure below the third threshold value, shale in a concentration below the fourth threshold value, hydrocarbon production below the fifth threshold value, temperature below the sixth threshold value, and sand in a concentration below the seventh threshold

20   value.

8. The method of claim 1, wherein the first signal segment is a portion of a seismic trace

9. The method of claim 8, wherein a dominant waveform exists in the first signal segment and is an apparently substantially random waveform.

10. The method of claim 9, wherein the dominant waveform of the first signal segment effectively obscures other waveforms.

11. The method of claim 10, wherein weighting comprises applying weights selected based on their effectiveness to neutralize the random contribution of the dominant waveform.

12. The method of claim 1, wherein expanding comprises dividing the first and second signal segments into selected frequency bands.

13. The method of claim 12, wherein a first feature operator of the at least one feature operator provides selected central frequencies and corresponding frequency widths to define the boundaries of the selected frequency bands.

14. The method of claim 12, wherein expanding comprises dividing the first and second signal segments into selected time segments and wherein a second feature operator of the at least one feature operator provides selected central times and corresponding times widths to define the boundaries of the selected time segments.

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15. The method of claim 14, wherein collapsing comprises superimposing the weighted plurality of first feature segments to form a first feature comprising a non-random first pattern and the weighted plurality of second feature segments to form a second feature having a second pattern distinct from the non-random first pattern.

16. A method comprising:

providing a first signal corresponding to a first geological formation tapped by a hydrocarbon well producing hydrocarbons above a threshold rate;

providing a second signal corresponding to a second geological formation tapped by a

5   hydrocarbon well producing hydrocarbons below the threshold rate;

expanding the first and second signal segments in at least one of frequency space and time space by applying at least one feature operator to the first and second signal segments to generate a plurality of first feature segments corresponding to the first signal segment and a plurality of second feature segments corresponding to the second signal segment;

10   weighting the pluralities of first and second feature segments by applying a weight table to the pluralities of first and second feature segments to generate a weighted plurality of first feature segments and a weighted plurality of second feature segments, respectively;

superimposing the weighted plurality of first feature segments to form a first feature comprising a non-random first pattern and the weighted plurality of second feature segments

15   to form a second feature having a second pattern distinct from the non-random first pattern; and

generating a separation key listing the at least one feature operator used to expand the first and second signal segments and the weighting table applied to the pluralities of first and second feature segments.

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17. The method of claim 16, wherein the first signal is a pre-stack, migrated seismic trace.

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18. The method of claim 17, wherein the second seismic trace is a pre-stack, migrated seismic trace.

19. The method of claim 16, wherein the first seismic trace is a post-stack, migrated seismic trace.

20. The method of claim 19, wherein the second seismic trace is a post-stack, migrated seismic trace.

21. The method of claim 16, wherein the hydrocarbon well is an oil well.

22. The method of claim 16, wherein the hydrocarbon well is a gas well.

23. The method of claim 16, wherein expanding comprises dividing the first and second signal segments into selected frequency bands and wherein a first feature operator of the at least one feature operator provides selected central frequencies and corresponding frequency widths to define the boundaries of the selected frequency bands.

24. The method of claim 23, wherein the first feature operator imposes a Gaussian weighting at centered at each of the selected central frequencies to define the selected frequencies bands.

25. The method of claim 23, wherein expanding comprises dividing the first and second signal segments into selected time segments and wherein a second feature operator of the at least one feature operator provides selected central times and corresponding times widths to define the boundaries of the selected time segments.

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26. The method of claim 25, wherein the second feature operator imposes a Gaussian weighting centered at each of the selected central times to define the selected time segments.

27. The method of claim 23, wherein collapsing comprises superimposing the

10   weighted plurality of first feature segments to form a first feature comprising a non-random first pattern and the weighted plurality of second feature segments to form a second feature having a second pattern distinct from the non-random first pattern.

28. The method of claim 27, further comprising providing a third signal

15   corresponding to a third geological formation containing a prospective hydrocarbon well location.

29. The method of claim 28, further comprising processing third signal in accordance with the at least one feature operator and weighting table listed in the separation key to

20   produce a third feature.

30. The method of claim 29, further comprising classifying the prospective hydrocarbon well location as one of hydrocarbon well producing above the threshold rate and a hydrocarbon well producing below the threshold rate based on the correspondence of the third feature to one of the first feature and the second feature.

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31. A method for predicting the state of a geological formation, the method comprising:

providing a separation key effective to extract a first feature from a signal corresponding to a first state and a second feature, distinct from the first feature, from a

5 signal corresponding to a second state, the separation key listing at least one feature operator and a weighting table;

providing a first test signal collected from the geological formation;

applying the at least one feature operator to expand the first test signal in at least one of frequency space and time space to generate a plurality of feature segments;

10 generating a weighted plurality of feature segments by applying the weighting table to the plurality of feature segments;

collapsing the weighted plurality of feature segments to generate a third feature; and

classifying the geological formation as having one of the first state and second state based on the correspondence of the third feature to one of the first feature and second feature.

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32. The method of claim 31, further comprising providing a second test signal collected from the geological formation at a time after the first test signal was collected.

33. The method of claim 32, further comprising processing the second test signal by

20 applying the at least one feature operator, applying the weight table, and collapsing to generate a forth feature.

34. The method of claim 33, further comprising quantifying changes in the geological formation between the time the first test signal was collected and the time the second test signal was collected by comparing the fourth feature to the first feature.

5   35. The method of claim 31, further comprising selecting a color spectrum comprising at least two colors and having a first extreme and a second extreme, opposite the first extreme, and assigning the color of the first extreme to the first feature and the color of the second extreme to the second feature.

10   36. The method of claim 35, further comprising assigning the third feature a color selected from the color spectrum based on the relative correspondence of the third feature to the first and second features.

37. The method of claim 36, further comprising providing a plurality of test signals, 15   each collected from a different location on the geological formation.

38. The method of claim 37, further comprising processing the plurality of test signals by applying the at least one feature operator, applying the weight table, and collapsing to generate a plurality of features.

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39. The method of claim 38, further comprising assigning each of the plurality of features a color selected from the color spectrum based on the relative correspondence thereof to the first and second features.

5   40. The method of claim 39, further comprising generating a two-dimensional image of the geological formation by coloring portions of the image in accordance with the color assigned to the feature of the plurality of features corresponding to the portions.

41. A method for predicting the presence of extractable hydrocarbons in a geological

formation, the method comprising:

providing a separation key effective to extract a first feature from signal collected

from a first geological formation tapped by a hydrocarbon well producing above a threshold

5   rate and a second feature from signal collected from a second geological formation tapped by

a hydrocarbon well producing below the threshold rate, the separation key listing at least one

feature operator and a weighting table;

providing a test signal collected from a third geological formation;

applying the at least one feature operator to expand the test signal in at least one of

10   frequency space and time space to generate a plurality of feature segments;

generating a weighted plurality of feature segments by applying the weighting table to

the plurality of feature segments;

superimposing the weighted plurality of feature segments to generate a third feature;

and

15   classifying the third geological formation as one of producing hydrocarbons above the

threshold rate and producing hydrocarbons below the threshold rate based on the

correspondence of the third feature to one of the first feature and second feature.

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